Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices

UNITED STATES
DEPARTMENT OF AGRICULTURE
CIRCULAR No. 225

Washington, D. C. June, 1932

RECEIVED
MAY 1932
BUREAU OF
AGRICULTURAL ECONOMICS

UTILIZATION OF BIGLEAF MAPLE OF THE PACIFIC NORTHWEST

By

HERMAN M. JOHNSON

Engineer in Forest Products
Pacific Northwest Forest Experiment Station
Branch of Research, Forest Service

FOR SALE BY THE SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C.

CIRCULAR No. 225 JUNE, 1932
UNITED STATES DEPARTMENT OF AGRICULTURE
WASHINGTON, D. C.

UTILIZATION OF BIGLEAF MAPLE OF THE PACIFIC NORTHWEST

By Herman M. Johnson

Engineer in Forest Products, Pacific Northwest Forest Experiment Station, Branch of Research, Forest Service

CONTENTS

	Page
Importance of the species	1
Range	2
Annual production and consumption	4
Properties of bigleaf maple wood	5
General description	5
Structure and identification	5
Physical and mechanical properties	6
Decay resistance	8
Utilization by industries	9
Furniture	10
Chairs	11
Veneers	13
Handles	15
Fixtures	15
Motor vehicles	15
Woodenware and novelties	16
Destructive distillation	16
Utilization by Industries—Continued.	
Miscellaneous and potential uses	17
Seasoning	18
Methods of lumbering	24
Logging	24
Milling	25
Transportation	28
By water	29
By autotrucks	29
By railroad	30
Lumber rates	31
Stumpage, log, and lumber values	32
Classified list of uses for bigleaf maple	33
Reported uses	33
Possible uses for bigleaf maple	34
Summary	34

IMPORTANCE OF THE SPECIES

Bigleaf maple (*Acer macrophyllum*), although available only locally and in comparatively small quantities, is yet one of the important commercial hardwoods of the Pacific Northwest. It owes its importance both to the intrinsic qualities of the wood (which possibly have not yet been fully appreciated) and to the scant supply of other hardwoods throughout its range. Hardwoods suitable for the exposed parts of high-grade furniture, cabinets, panels, and similar products are not available in large commercial quantities anywhere west of the Rocky Mountains. For first-quality plywood, veneers, flooring, and the like, the Pacific Northwest must now go, in large measure, to manufacturers operating in the Central and Southern States. Hardwoods in the Pacific Northwest never were plentiful in the sense that they were in the East, and, except red alder, the better and more accessible have been materially reduced by logging and land clearing.

The wood of bigleaf maple enters into many of the different uses associated with the eastern maples; many of its properties, both mechanical and physical, compare favorably with those of the eastern species. Its excellent gluing and finishing qualities, workability, hardness, and strength make it very desirable for flat and turned parts of furniture, chairs, novelties, and the like. It is especially

valuable for furniture and chairs when finished to imitate walnut and mahogany.

Bigleaf maple and such other local hardwoods as red alder (*Alnus rubra*), black cottonwood (*Populus trichocarpa*), Oregon ash (*Fraxinus oregona*), Oregon white oak (*Quercus garryana*), and western paper birch (*Betula papyrifera occidentalis*) are supplying wood-using industries in Oregon and Washington that otherwise would be handicapped by the lack of raw material; and, in turn, the industries so supported afford additional means for the utilization within the region of the abundant supplies of softwoods. It may, therefore, be said that only as steps are taken to conserve and, indeed, to enlarge the supply of these few local hardwoods can the expectation of continued growth in the furniture, chair, and similar wood-using industries be realized.

Possibilities for growth in the furniture and chair industries seem to be particularly good. By 1927, the number of furniture and chair factories in Oregon and Washington reached 94,[1] or an increase of about 50 per cent since 1918, while the value of their output was valued at $12,000,000, or more than double the 1918 value. Even so, more than half the furniture used on the Pacific coast is said to be shipped from the East, suggesting the possible expansion of the local industry, and a corresponding increase in the local demand for hardwoods, without invading outside markets.

RANGE

Only a very general estimate of distribution and occurrence of bigleaf maple can be given. No one would be warranted in presenting even an approximate estimate of the marketable supply. Reliable data on the volume of this and other commercial hardwoods of the Pacific Northwest can be obtained only by a thorough-going survey, something that has never been attempted.

Although the general range of bigleaf maple is from southeastern Alaska southward through the coast region to southern California and along the western slopes of the Cascade Range and Sierra Nevada in Washington, Oregon, and California, it is only on bottoms and springy hillsides in the coastal regions of Oregon and Washington, where it reaches its best development, that the species attains sufficient size and abundance to be of any real commercial importance. Here it is usually found in alluvial river bottoms, along the margins of foothills and low mountain streams, or on particularly well-watered slopes. Although occasionally it forms pure stands of small extent, bigleaf maple commonly occurs throughout its range as an incidental species, in small clumps or as scattered trees in mixture with Douglas fir (*Pseudotsuga taxifolia*), western red cedar (*Thuja plicata*), western hemlock (*Tsuga heterophylla*), lowland white fir (*Abies grandis*), red alder, black cottonwood, and Oregon ash.

Over most of its range it is a small tree, averaging about 50 feet in height and 18 inches in diameter. On good soils in Oregon and Washington, in competition with much taller conifers, it is sometimes 100 feet high and 40 inches or more in diameter. (Fig. 1.)

[1] Includes some companies engaged in the manufacture of metal and rattan furniture.

FIGURE 1.—Old-growth bigleaf maple trees. The two trees in the foreground, which average about 38 inches in diameter and 90 feet in height, are typical of much of the remaining old-growth timber. The old growth is usually limby and otherwise more or less deformed

In the open the trees have short trunks and dense, round-topped crowns, while those in dense stands produce timber comparatively clear of branches from one-half to two-thirds of their height. Even then the bole is rarely without bad crooks, forks, burls, or other defects, which reduce to a considerable extent the value of the species for commercial purposes. In poor situations or at the higher elevations bigleaf maple is sometimes scrublike.

ANNUAL PRODUCTION AND CONSUMPTION

As already implied, production and consumption of bigleaf maple lumber and veneer are largely confined to Oregon and Washington. Some of the larger users of bigleaf maple feel that consumption has reached its peak and that a decline may be expected shortly. Such judgments doubtless are the outcome of an increasing difficulty in obtaining ample supplies of bigleaf maple logs at existing prices, which have shown no marked increase in the last decade or more. An advance in prices doubtless would have the effect of making marketable much timber that can not now be handled at a profit.

Such statistics as are available show that the consumption of bigleaf maple is increasing. Oregon and Washington used 3,400,000 board feet of bigleaf maple in 1910 and 4,900,000 board feet in 1923. A survey of their requirements for 1928 indicated that consumption rose in the next five years to about 8,040,000 board feet, of which Oregon consumed at least 5,170,000 board feet and Washington more than 2,860,000. These figures include 221,000 board feet of timber consumed for veneer (Oregon 211,000 board feet and Washington about 10,000). They do not include 400,000 board feet of lumber shipped to California and other States, 90 per cent of which originated in Washington: or the veneer from 10,000 feet of logs shipped from Washington to the East.

The cut of bigleaf maple in Oregon and Washington in 1928 amounted to 8,449,500 board feet, or less than 0.2 per cent of the cut of hardwood lumber in the United States. As some of the lumber produced in Washington was consumed in Oregon, California, and other States, and as some of the logs produced in Washington were sawed in Oregon, it is difficult to determine the 1928 production definitely as between the two States. It is estimated, however, that Oregon produced 3,598,800 board feet (lumber tally) of bigleaf maple logs (including veneer logs) and 3,822,800 feet of lumber, and that Washington produced 4,850,700 feet of logs and 4,395,700 feet of lumber. Oregon consumed a total of 211,000 feet of logs in veneer manufacture and Washington 20,000. In 1928 about 65 per cent of the bigleaf maple logs cut were sawed by the wood-using factories, the remainder by small operators who sold their lumber output in the open market.

On request, the Pacific Northwest Forest Experiment Station, Portland, Oreg., will furnish to any one interested a directory of producers and consumers of bigleaf maple, in Oregon and Washington.

PROPERTIES OF BIGLEAF MAPLE WOOD

GENERAL DESCRIPTION

A cross section of the trunk of a bigleaf maple tree shows no plainly visible distinction between heartwood and sapwood; both are nearly white and of high moisture content. When fully seasoned, the surface of the wood is light brown with a pale-red tint. This change in color is not undesirable, since the bulk of the wood as now used is stained to imitate walnut or mahogany. The rings of annual growth are fairly distinct, the summer wood appearing as a thin, dark line separating the growth of one year from that of the next.

Bigleaf maple has a straight grain as a rule and a fine uniform texture. Curly and bird's eye figures occur less frequently than in the eastern maples. Burls, which show a very distinctive figure in veneer, are quite common. But rarely does the lumber show streaks running in a vertical direction, known as pith-ray flecks,[2] such as are found in the eastern soft maples, birch, cherry, red alder, and a number of other woods.

The wood is lighter in weight than that of any of the eastern species except silver maple (*Acer saccharinum*). Although by no means so strong or hard as sugar maple (*A. saccharum*), it is superior to silver maple in all mechanical properties except shock resistance.

It turns and otherwise works well with tools, glues very satisfactorily, and takes a good polish. It also takes paint and enamel well and makes an excellent imitation mahogany or walnut when stained. If properly dried and cared for, bigleaf maple does not shrink, swell, check, or warp seriously in place.

STRUCTURE AND IDENTIFICATION

Bigleaf maple is a diffuse porous wood. The pores are so small as to be invisible without magnification. They are fairly uniform in size and quite evenly distributed in all parts of the annual ring; those in the early springwood are slightly more abundant. The wood rays are only one to three cells wide. Even the largest ones are not as broad as the pores. They are not only less distinct but they appear much closer together than in sugar maple. Plate 1 shows the structure of the wood in transverse, radial, and tangential sections.

The general appearance of the wood when dry is quite similar to that of the eastern maples, save for its light, reddish-brown color. With the possible exception of western paper birch, the wood of bigleaf maple can be distinguished easily from the other commercial hardwoods of the Pacific Northwest. It is slightly darker in color than western paper birch, also softer and lighter in weight. Its reddish-brown tinge is not as pronounced as in fully seasoned red alder, nor are its annual-growth rings ordinarily as wide. It differs so greatly from Oregon ash, Oregon white oak, and black cottonwood that it is not likely to be mistaken for any one of them.

---

[2] Brown, H. P. PITH-RAY FLECKS IN WOOD. U. S. Dept. Agr., Forest Serv. Circ. 215, 15 p., illus. 1913.

PHYSICAL AND MECHANICAL PROPERTIES

Bigleaf maple wood is moderately heavy, moderately hard, and moderately strong. Compared on a basis of density or weight, it has nearly average or slightly better than average properties. It is somewhat below the average in shock resistance. In the classifications of woods by the Forest Products Laboratory of the Forest Service, according to the results for each of six physical and mechanical properties, bigleaf maple is classified as follows:

Property	Classification
Density or weight	Moderately heavy.
Strength as a beam or post	Moderately strong.
Hardness	Moderately hard.
Shock resistance	Moderately low.
Stiffness	Moderately stiff.
Shrinkage	Moderately large.

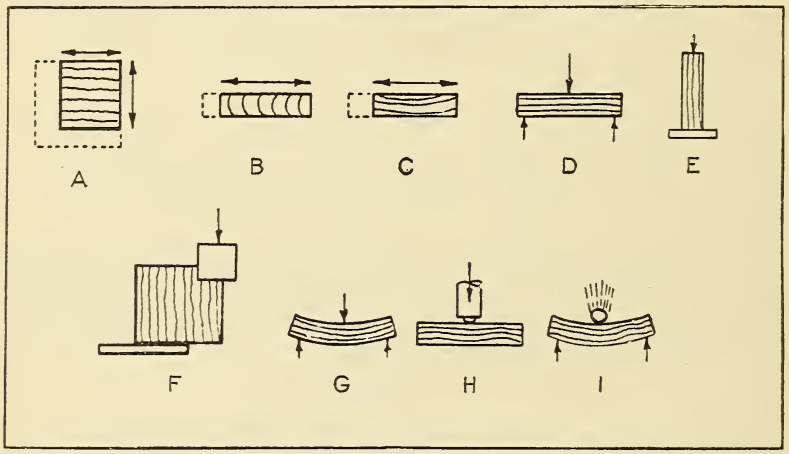


FIGURE 2.—Illustration of physical and mechanical tests: A, Volumetric shrinkage; B, radial shrinkage; C, tangential shrinkage; D, bending strength; E, compressive strength (endwise); F, shearing strength; G, stiffness; H, hardness; and I, shock resistance

The following tabulation [3] shows the actual and comparative properties of bigleaf maple, as determined by the Forest Service, with eastern white oak (*Quercus alba*) as a basis for comparison. The composite values given are weighted averages of several values derived from different kinds of strength tests (fig. 2); for example, strength as a beam or post is a combination of values derived from tests in static bending, impact bending, and compression parallel to grain. It will be noted that bigleaf maple is low both in hardness and shock resistance, as compared with white oak. As a beam or post bigleaf maple is about seven-eighths as strong as white oak.

Locality where grown		Washington
Weight per cubic foot:		
Green	pounds	47
Air-dry, 12 to 15 per cent moisture content	do	34
Kiln-dry, 8 per cent moisture content	do	32

[3] Based on data taken from the following bulletins: NEWLIN, J. A., and WILSON, T. R. C. MECHANICAL PROPERTIES OF WOODS GROWN IN THE UNITED STATES. U. S. Dept. Agr. Bul. 556, 48 p., illus. 1923 (revised); and MARKWARDT, L. J. COMPARATIVE STRENGTH PROPERTIES OF WOODS GROWN IN THE UNITED STATES. U. S. Dept. Agr. Tech. Bul. 158, 39 p. illus. 1930.

Specific gravity, based on oven-dry weight and volume when green	0.44
Specific gravity, based on oven-dry weight and volume when oven-dry	0.51
Specific gravity, based on oven-dry weight and volume when air-dry	0.48
Shrinkage from green to oven-dry condition:	
In volume (fig. 2, A)—per cent	11.6
Radial (fig. 2, B)—do	3.7
Tangential (fig. 2, C)—do	7.1
Comparative shrinkage (twice volume plus radial plus tangential divided by 3)—per cent	11.3
Strength in bending at 12 per cent moisture content (fig. 2, D):	
Modulus of rupture—pounds per square inch	10,800
Relative strength as compared with white oak (white oak=100)	71
Strength in compression parallel to grain at 12 per cent moisture (fig. 2, E):	
Maximum crushing strength—pounds per square inch	6,090
Relative strength as compared with white oak (white oak=100)	82
Shearing strength parallel to grain at 12 per cent moisture content (fig. 2, F):	
Shearing strength—pounds per square inch	1,770
Relative shearing strength compared with white oak (white oak=100)	85
Composite values:	
Strength as a beam or post	84
As compared with white oak (white oak=100)	85
Hardness	73
As compared with white oak (white oak=100)	68
Shock-resistance	78
As compared with white oak (white oak=100)	61
Stiffness	132
As compared with white oak (white oak=100)	87

Table 1 compares the relative properties of bigleaf maple with those of other commercial hardwoods of the Pacific Northwest, together with red gum (*Liquidambar styraciflua*), chestnut (*Castanea dentata*), yellow poplar (*Liriodendron tulipifera*), and the principal eastern maples, which are often put to the same uses. The faculty of shrinking and swelling less, under varying moisture conditions, than any of these except chestnut gives bigleaf maple an advantage. This property makes it desirable in built-up stock for both flat and turned parts of chairs and furniture. The fact that tangential shrinkage (7.1 per cent) is nearly double the radial shrinkage (3.7 per cent), indicates that quarter-sawed stock should be used when greatest ability to stay in place is desired. Although not used for panel cores as extensively as red alder, bigleaf maple is satisfactory for this purpose. Red alder is not only more abundant than bigleaf maple, but is considered to be slightly better for cores, as its lower specific gravity overbalances the disadvantage of its somewhat greater shrinkage.

The mechanical properties of bigleaf maple when considered collectively compare favorably with those of the other woods listed in Table 1. In bending and crushing, and consequently in the composite value of strength as a beam or post, sugar maple alone shows a large excess over bigleaf maple. In stiffness also, an essential property in turned parts, bigleaf maple is surpassed by few of the woods listed. For legs, stretchers, and similar turned parts, bigleaf maple and red alder, especially the latter, have to a large extent supplanted red gum in the furniture industry of the Pacific Northwest. Bigleaf maple compares less favorably in ability to resist shock and in hardness.

TABLE 1.—*Properties of bigleaf maple compared with other Pacific Northwest hardwoods, also with eastern maples, red gum, chestnut, and yellow poplar* [1]

Species	Specific gravity [2]	Weight		Shrinkage [4]			Strength [5]		Composite values				
		Dry [3]	Green	Volumetric	Radial	Tangential	Bending (A)	Crushing (B)	Strength (beam or post)	Hardness	Shock resistance	Stiffness	Comparative shrinkage
Bigleaf maple (Acer macrophyllum)	100	100	100	100	100	100	100	100	100	100	100	100	100
Red maple (Acer rubrum)	111	112	106	113	108	115	124	107	107	108	141	120	113
Silver maple (Acer saccharinum)	100	97	96	103	81	101	84	88	83	89	119	80	101
Sugar maple (Acer saccharum)	130	129	119	128	132	134	145	130	132	158	177	135	130
Red gum (Liquidambar styraciflua)	100	100	106	129	141	139	110	96	98	82	127	102	133
Chestnut (Castanea dentata)	91	88	117	100	92	94	81	91	82	68	88	85	98
Yellow poplar (Liriodendron tulipifera)	86	82	81	106	108	100	86	89	85	55	74	102	105
Red alder (Alnus rubra)	84	82	98	109	119	103	93	98	94	66	91	105	109
Oregon ash (Fraxinus oregona)	114	112	98	114	111	114	119	101	105	129	158	108	114
Oregon white oak (Quercus garryana)	145	150	147	116	114	127	95	110	104	210	163	81	118
Black cottonwood (Populus trichocarpa)	73	71	98	107	97	121	79	74	71	40	76	90	109

[1] Based on data from the following bulletins: NEWLIN, J. A., and WILSON, T. R. C. MECHANICAL PROPERTIES OF WOODS GROWN IN THE UNITED STATES. U. S. Dept. Agr. Bul. 556, 48 p., illus. 1923; MARKWARDT, L. J. COMPARATIVE STRENGTH PROPERTIES OF WOODS GROWN IN THE UNITED STATES. U. S. Dept. Agr. Tech. Bul. 158, 38 p., illus. 1930.

[2] Based on oven-dry weight and volume when green.

[3] At about 12 per cent moisture content.

[4] From green to oven-dry condition, expressed in percentage of dimension when green.

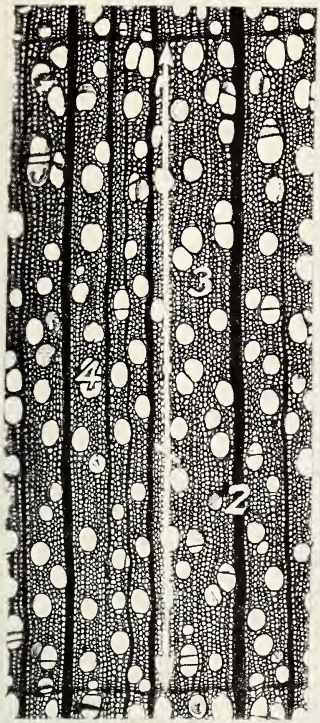
[5] Strength at 12 per cent moisture content; (A) modulus of rupture in bending; (B) compression parallel to grain (maximum crushing strength).

DECAY RESISTANCE

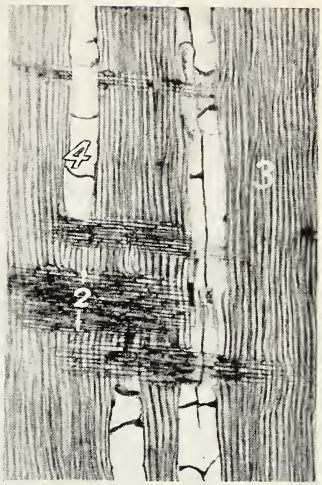
When exposed to conditions that favor decay, wood in warm humid areas of the United States decays more rapidly than in cool or dry areas. The natural decay resistance of all common native species of wood is in the heartwood; the untreated sapwood of practically all species has low resistance under decay-producing conditions. The degree of decay resistance or durability of heartwood in service is greatly influenced by differences not only in the character of the wood but also in the attacking fungus and the conditions of exposure. Moisture and temperature are the principal factors which affect the rate of decay; they vary greatly with the local conditions surrounding the wood in service. Therefore wide differences in length of life may be noted in pieces of wood of the same species or even those cut from the same tree and used under apparently similar conditions.

In contact with the ground or under other conditions favorable to the attack of wood-destroying fungi, bigleaf maple is rather low in decay resistance. Logs left in damp situations during the warm months are likely to become infected within three or four weeks. The life of bigleaf maple fence posts will not ordinarily exceed three to five years; the wood is used for posts only occasionally, and then only where more durable local woods, such as Douglas fir, or better, western red cedar, are not available.

General comparisons of the relative decay resistance of different species must be estimates: they can not be exact, and they may be very misleading. Experience, however, suggests that the heartwood of bigleaf maple when used under conditions that favor decay is only about one-third as durable as western red cedar. It is only about



A—Transverse Section

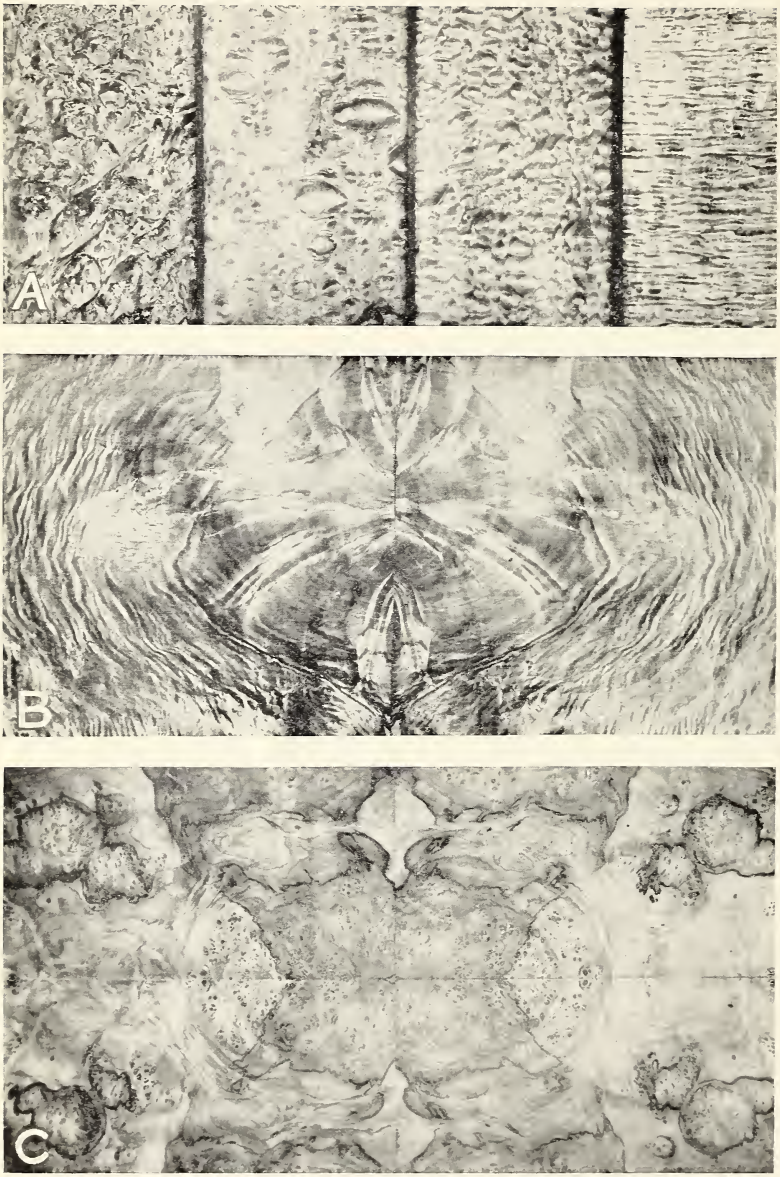


B—Radial Section

C—Tangential Section

HIGHLY MAGNIFIED SECTIONS OF BIGLEAF MAPLE SHOWING STRUCTURE

Numbers signify as follows: 1, Width of annual rings; 2, wood rays; 3, wood fiber; 4, vessel.



EXAMPLES OF FIGURED BIGLEAF MAPLE VENEER

A, The types of figure, from left to right, are burl, blister, quilted, and curly; B, 2-way matched veneer; C, 4-way matched veneer.

one-half as durable as Douglas fir and Oregon white oak, just about as durable as Oregon ash, and more durable than red alder, black cottonwood, and the true firs.

UTILIZATION BY INDUSTRIES

The bigleaf maple cut in Oregon and Washington in 1928, excepting that used for fuel, was largely consumed by the secondary wood-using industries of these States in the form of logs, lumber, and veneer; about 400,000 board feet of lumber and a negligible quantity of veneer were shipped out of the two States, mostly to California.

Table 2 shows the relative demands made on bigleaf maple by the secondary wood-using industries of Oregon and Washington and by veneer manufacturers in 1910, 1923, and 1928. It will be noted that total consumption in these States has increased 65 per cent since 1923 and 135 per cent since 1910; also that a few industries which formerly used substantial quantities of bigleaf maple are now consuming greatly reduced quantities or none at all.

TABLE 2.—*Summary of bigleaf maple used in secondary industries and by veneer manufacturers in Oregon and Washington, 1910, 1923, and 1928* [1]

Industry	1910	1923	1928
	Board feet	*Board feet*	*Board feet*
Furniture	2,916,300	1,579,000	4,824,000
Chairs		2,661,000	2,823,000
Handles	40,000	70,000	67,000
Fixtures	19,000	60,000	54,000
Vehicles and vehicle parts		17,000	22,500
Boats	500		10,000
Woodenware and novelties		250,000	10,000
Saddles	6,000		4,000
Miscellaneous	35,800	57,000	4,000
General millwork	370,000	134,000	
Pulleys	22,000		
Baskets	5,000	5,000	
Total	3,414,600	4,833,000	7,818,500
Veneer		50,000	221,000
Grand total	3,414,600	4,883,000	8,039,500

[1] In most instances where no bigleaf maple was reported, very small quantities of the wood doubtless were used.

The secondary wood-using industries in Washington and Oregon are not only consuming the bulk of the bigleaf maple lumber produced in these States but they are also continually increasing the proportion of the lumber which they themselves produce. In 1928 independent hardwood mills engaged solely in the production of hardwood lumber produced 2,953,500 board feet of bigleaf maple. The remainder, or 4,865,000 feet, was produced by the secondary wood-using industries, almost entirely from purchased logs. The operation of hardwood sawmills by the secondary wood-using industries has certain advantages. Aside from possible economies, the practice assures an adequate and dependable supply of lumber. Then, too, it usually results in better lumber and closer utilization of the log.

Except that red alder is preferred for cores in built-up panels, bigleaf maple because of its properties already discussed is considered

the most desirable of the local hardwoods for turned and other exposed parts, as well as hidden parts, in furniture and chair manufacture, especially of the better grades.

The largest demand for bigleaf maple on the part of the secondary industries, as shown by Table 2, is made by the furniture industry, which used in 1928 nearly 60 per cent of the cut. Next in order is the chair industry, which used 35 per cent. Veneer, practically all of which is consumed by the furniture industry, accounted for nearly 3 per cent. The remainder was used for handles, fixtures, motor vehicles, boats, woodenware and novelties, saddles, and miscellaneous articles.

FURNITURE

The furniture industry of the Pacific Northwest is becoming increasingly important not only in the quantity of material used but also in the value of the products manufactured. In 1923 (year of

FIGURE 3.—Bigleaf maple logs utilized by the furniture and chair industries. They are 8 feet long and 12 to 18 inches in diameter at the top

latest available data) the total quantity of hardwoods and softwoods consumed by the industry in Oregon and Washington amounted in round numbers to 20,000,000 board feet. In 1928, it is estimated, the furniture industry of these two States consumed approximately 35,000,000 feet—an increase of 75 per cent in the intervening 5-year period. Of the 4,824,000 board feet of bigleaf maple lumber consumed in 1928, 3,667,000 feet was produced by the industry itself from purchased logs. (Fig. 3.) The remainder was purchased in the form of rough lumber, most of it in green condition.

Bigleaf maple is used chiefly for a medium-grade living-room, dining-room, and bedroom furniture of both plain and fancy designs, finished in walnut, mahogany, or enamel—ordinarily for crossbanding and backing in such built-up flat parts as tops, panels, and drawer ends. In living-room furniture finished in walnut or mahogany its use is mostly confined to such solid parts as legs,

stretchers, rails, and slides of tables. Certain pieces of living-room furniture, however, such as bookcases, rockers, benches, stools, and radio tables, are made entirely of bigleaf maple. Living-room tables are occasionally so made also, except that the tops are of built-up construction and faced with walnut or mahogany veneer. In dining-room furniture finished in walnut or mahogany, bigleaf maple is used for legs, stretchers, and rails of tables; all parts of chairs, but especially legs, stretchers, back posts, and other turned parts; and the legs, stretchers, crowns, rails, and mirror frames of buffets. Small dining tables are sometimes made entirely of bigleaf maple, also enameled breakfast tables and tea wagons. Its particular use in bedroom furniture depends on the character of the finish. Finished in walnut or mahogany, it is used for legs, front rails, side rails, mirror posts, and mirror frames of dressers, chiffoniers, and dressing tables, also posts, side rails, and turned parts of bedsteads. Under enamel finish it is used for all exposed parts of chiffoniers, dressers, bureaus, and vanity tables, including the facing of panels; the posts, side rails, and turned parts of bedsteads; and the legs, stretchers, back posts, and seat frames of chairs. Sound-knotted stock is suitable for enamel finish, except in parts requiring maximum strength. This grade of material can not be used in the exposed parts with other finishes.

Bigleaf maple is used but little in the manufacture of cheap furniture. A comparatively small quantity is made into kitchen tables, but its use is mostly confined to the legs, stretchers, banisters, and slats of chairs.

About one-tenth of the bigleaf maple consumed by the furniture industry enters into the production of overstuffed and upholstered articles, including davenports, davenport beds, benches, stools, and chairs. It is desired for the frames of overstuffed furniture, especially parts subject to strains, such as back frames, back posts, and legs; also for exposed parts, such as front rails, arms, and molding. In chairs with upholstered seats and backs the wood is used in all exposed parts, such as back posts, legs, stretchers, arms, arm posts, and seat frames.

Of the 4,824,000 board feet of bigleaf maple consumed by the furniture industry proper of Oregon and Washington in 1928, about 5 per cent was used in the manufacture of wooden chairs. Furniture also includes some overstuffed chairs, but mostly as part of furniture sets. In general, the production of chairs is a specialized industry.

CHAIRS

The chair industry is here considered as separate from the furniture, and as consisting of factories that produce chairs exclusively. The chairs produced are mostly of standard design and pattern and include living-room, dining-room, bedroom, library (public), office, lodge, kitchen, and nursery chairs, rockers, and stools.

In point of consumption bigleaf maple ranks first among the woods manufactured into chairs in Oregon and Washington. In addition to the 2,823,000 board feet, or about 45 per cent of all the hardwoods consumed by the chair industry of these States in 1928, it is estimated that the furniture industry took an additional 240,000

feet for the production of chairs. The combined consumption of other local hardwoods for this purpose amounted to 3,121,700 board feet: Red alder 2,600,000, black cottonwood 441,000, Oregon white oak 50,000, Oregon ash 17,700, and western paper birch 13,000. The industry also used 275,600 feet of eastern oak and 60,000 feet of Japanese oak.

Bigleaf maple has proved an excellent wood for all the different grades of chairs manufactured by the local industry, including cheap wood-seat, medium-grade, and enameled chairs. As has been noted, it works easily, glues and holds screws well, and takes a satisfactory mahogany, walnut, or enamel finish. In strength it compares favorably with most woods used by the chair industry at large. Less wood waste, moreover, is considered to result from its use than from that of any other native hardwood.

In the manufacture of cheap or low-grade chairs, including wood-seat diners, rockers, and kitchen chairs, bigleaf maple is in demand for all parts except rims and pillars, but principally for legs, spindles, stretchers, slats, back posts, and banisters. In certain designs or patterns of this grade, it is used for all parts except the seat, stretchers, and spindles; in cheap wood-seat rockers, only for the runners. Its particular use in different factories depends to a great extent on the opinion of operators. For example, one operator has turned from red alder to bigleaf maple for legs and stretchers, claiming that red alder lacks the necessary strength, while another is using red alder for this purpose, claiming that red alder gives very satisfactory results.

Bigleaf maple is used more generally in the manufacture of medium-grade chairs. In dining and living-room chairs of this grade, finished in walnut or mahogany, it is used for turned, square, and flat parts, including legs, stretchers, spindles, slats, banisters, seats, seat frames, posts, pillars, rims, crowns, arms, arm posts, and rails. It enters at one time or another into all parts of medium-grade rockers, but is generally limited to the runners, top slats, rails, arms, and arm posts. Many of the so-called mahogany chairs of the better grade are made entirely of this wood, as are also office and library chairs in various finishes and natural-finish tablet-arm chairs for schools and colleges.

Bedroom, dressing, and nursery chairs, finished in enamel, may be entirely of bigleaf maple, but in most instances its use is confined to arms, arm posts, back posts, banisters, rims, crowns, top slats, and rockers.

Bigleaf maple is used in both hidden and exposed parts of upholstered and overstuffed chairs. In overstuffed chairs it is used in all parts, especially for back frames, legs, rails, back posts, arms, and rockers. In chairs with upholstered seats and backs, finished in walnut and mahogany, it is used for back posts, arm posts, arms, rails, top slats, and legs.

The general practice of the chair factories is to purchase their supply of bigleaf maple in the form of logs; in fact, more than 85 per cent of the wood used is delivered in this form and converted into lumber by the factories themselves. With simple equipment, usually limited to a circular headsaw and carriage, the logs are sawed into 1 to 3 inch lumber.

VENEERS

Little of the hardwood veneer made in the Pacific coast region can be substituted to fill the demand for such veneer woods as black walnut (*Juglans nigra*) and true mahogany (*Swietenia* spp.). The local veneer is rarely cut thinner than one-sixteenth of an inch, whereas face veneer, as used in the furniture industry, is almost entirely one twenty-eighth to one-thirtieth of an inch in thickness. Consequently, most of the high-grade face veneers of both domestic and imported woods used by western industries are bought from factories in the central or southern part of the United States. For other uses in furniture manufacture, however, bigleaf maple veneer is in steady demand.

Consumption of bigleaf maple logs and burls in veneer manufacture, as shown in Table 2, has increased more than fourfold in the 5-year period ended in 1928. Total consumption in Oregon and Washington in 1928 amounted to 231,000 board feet. The bulk of this veneer was used in these States—211,000 feet by the furniture industry and 10,000 feet by the general millwork factories. The remainder, or the cut from 10,000 feet of logs, crotches, and burls, was shipped from Washington to eastern furniture factories. In addition, bigleaf maple burls valued at approximately $50,000 were shipped to the Atlantic coast in 1928.

Two general classes of veneer, termed plain and figured, are produced from bigleaf maple. Other than this, there are no well-defined lines separating the different kinds. A relatively small quantity of highly figured veneer is cut by the stay-log process from burls, crotches, and stumps. (Pl. 2.) Burls are particularly highly figured with eyelets and bird's-eye effects. The plain veneer, produced from logs by the straight rotary-cut method and used mostly for backing and cross-banding, has little or no distinctive figure; except where the logs contain curly wood, the figure is made by the growth rings, and since the cutting is done in the direction of these rings a veneer with a comparatively large figure usually results.

Most of the bigleaf maple veneer is consumed by the furniture industry in the production of built-up lumber, or plywood, largely in the cross-banding and backing of both 3 and 5 ply panels faced with more expensive hardwoods, and occasionally for facing low-grade panels. A small proportion of the total cut of plain veneer is used as a facing or cross-banding stock in door manufacture. The highly figured veneers, marketed almost entirely in the East, are used for facing, overlay, and inlay materials in the most expensive grades of furniture.

The rotary-cut method of producing veneer, which is used extensively with different woods, takes logs cut into length suitable for the lathe, or from 4 to 6 feet. These sections or blocks are boiled in water for 12 to 36 hours, depending on their size, after which they are revolved rapidly against a fixed knife, which peels off a thin, continuous sheet. The knife is constantly advanced, the advance for each revolution of the log corresponding to the thickness of the veneer. Sometimes an additional smaller lathe is used to peel the log down to a 4-inch core.

The stay-log process, a development of the rotary method, is used for cutting highly figured veneer from burls, crotches, stumps, or

other curly wood. Although a slower and more expensive process, it is justified by the greater value of the product. To get the most out of a burl requires much care and experience. Usually the burl is first cut into several pieces, their number and shape depending on the size and form of the burl, the quality of the wood, and the kind of figure desired. In the stay-log process a plate, or stay log, is attached off center to an ordinary veneer lathe, with the piece of burl to be cut bolted to the stay log in such a way that the desired face of the burl will come against the knife each time the stay log rotates. The stay log, as an attachment, is usually adjustable for the sweep or diameter of cuts to be made. This process not only makes possible the use of varying forms of timber and the

FIGURE 4.—Bigleaf maple veneer logs. The logs shown are from 18 to 38 inches in diameter at the small end and 6 feet long; they are sound, straight, and surface clear

production of different kinds of veneer, but much of the heartwood, which by the rotary-cut method is ordinarily thrown away in the core, may be utilized.

Manufacturers of rotary-cut veneer prefer bigleaf maple logs that are 18 inches and more in diameter at the small end and clear of defects. Most firms will, however, take logs that are at least fairly clear and 16 inches and over in diameter, or even smaller ones down to 12 inches if they contain a high proportion of clear material. Some concerns do not buy veneer logs as such but rather limit their purchases to camp-run logs, from which material suitable for veneer is selected.

The price of plain veneer logs ranges from $22 to $26 per thousand board feet delivered at the local factory. (Fig. 4.) Highly figured logs, such as butts and crotches, bring a price of $40 to $60 per thousand feet. The burls, due to their irregular form, are sold by the pound. Those of commercial size weigh from 200 to about 5,000 pounds and sell at 3 to 6 cents a pound delivered at the local factory or point of shipment to the East. The best sizes for cutting weigh from 600 to 1,200 pounds. (Fig. 5.) Sound specimens are rarely found in the largest sizes.

HANDLES

In past years bigleaf maple was the favorite wood for long handles, such as broom, mop, and window-brush handles, because of its moderate weight, moderate hardness, good qualities, and ability to take an excellent finish. At the present time, however, these articles in the Pacific Northwest are made almost entirely of Douglas fir, a much more abundant wood.

Most of the bigleaf maple reported for handles in 1928, about 55,000 board feet, was utilized in the production of brush backs and short brush handles, items for which red alder and western paper birch are also used. In addition, 7,000 feet were used in the manufacture of pick and shovel handles, and 5,000 feet in small-tool

FIGURE 5.—Bigleaf maple burls. The specimens shown weigh from 400 to 1,500 pounds each

handles. The material for brush handles and backs is purchased in the form of lumber 1 to 3 inches thick and usually green. To insure straight-grained stock, the pick and shovel blanks are sawed at the factories from purchased bolts.

FIXTURES

Largely because of its finishing and wearing qualities, bigleaf maple is a desirable wood for fixtures. In this use, as in furniture and chairs, it is finished in walnut or mahogany or is enameled. The industry reported the use of 54,000 board feet of bigleaf maple in 1928, largely for counters (tops, framing, and rails), shelves, racks, cases, and drawers (sides and ends). That it is not more generally used in the production of fixtures is due to the scarcity of clear stock in long lengths and the difficulty of purchasing stock properly kiln dried.

MOTOR VEHICLES

The use of bigleaf maple in motor-driven vehicles is limited mainly to auto-body companies in Oregon and Washington engaged in the repair of various types of truck, delivery, and passenger

bodies, a large part of whose requirements are filled by wood shipped in from the East. The 22,500 feet of bigleaf maple reported in 1928 as used in this way went mostly for doorposts, top frames of inclosed bodies, filler and cross braces of commercial bodies, and sills and frames of cabs. More bigleaf maple doubtless would be used by this industry if properly kiln-dried stock could be purchased easily. Apparently the wood is better suited for the more important structural parts than for the relatively unimportant running boards, braces, seat risers, and the like, for which softwoods can as well be utilized. In ease of working, nail and screw-holding power, shock resistance, and strength in bending and compression, bigleaf maple compares favorably with the eastern maples, which are popular with auto-body manufacturers. Because of its smooth-wearing qualities and comparative freedom from slivers, it is desirable for the floors of delivery trucks.

WOODENWARE AND NOVELTIES

The classification woodenware and novelties ordinarily includes all kinds of serving utensils and other culinary articles, semiuseful and more ornamental articles, and many articles that can not be included under a distinctive heading. Then, too, establishments that make woodenware are frequently manufacturers of novelties as well as other articles, consuming similar stock and reporting their raw material together. The result is that it is not practical to make a definite statement as to the quantity of bigleaf maple consumed in the production of woodenware and novelties or the various articles included in this classification.

Bigleaf maple is or has been used in the production of floor lamps, candlesticks, smoke stands, table lamps, pedestals, umbrella stands, taborets, ferneries, sewing cabinets, hat racks, telephone stands and stools, footstools, coat hangers, towel racks, doorstops, tent stakes and toggles, dowels, ladder rungs, and reels; in these articles it is used for turned or other parts in much the same way and for the same purposes as in the case of furniture or chairs. It is or has been used for such woodenware as bread boards, meat boards, cloth boards, lapboards, cutting boards, scoops, cooking spoons, rolling-pins, outing and wire-end dishes, etc. The 10,000 feet of bigleaf maple reported under this general classification in 1928 was used largely in the production of smoke stands, sewing cabinets, and cooking spoons; a single concern produced 1,000,000 spoons for a large eastern manufacturer.

DESTRUCTIVE DISTILLATION

Results of distillation tests [4] made at the Forest Products Laboratory suggest that bigleaf maple will yield a smaller quantity of crude alcohol and acetate of lime than beech (*Fagus grandifolia*),

[4] Tests were made in the same way as those reported in the following bulletins:
HAWLEY, L. F., and PALMER, R. C. YIELDS FROM THE DESTRUCTIVE DISTILLATION OF CERTAIN HARDWOODS. U. S. Dept. Agr. Bul. 129, 16 p., illus. 1914.
PALMER, R. C. YIELDS FROM THE DESTRUCTIVE DISTILLATION OF CERTAIN HARDWOODS. SECOND PROGRESS REPORT. U. S. Dept. Agr. Bul. 508, 8 p., illus. 1917.
The results here reported are of most value when compared with laboratory distillations of species whose yields in commercial practice are well known. Laboratory methods are not directly comparable with commercial conditions, and the calculated yields per cord from laboratory distillations on 100 or 200 pounds of wood are frequently much higher than the yields from distilling several thousand pounds in a commercial plant.

sweet birch (*Betula lenta*), and sugar maple, the chief hardwoods used by the distillation industry of the United States. On the basis of oven-dry weight of wood the acetic-acid yield of bigleaf maple is considerably lower than that of the three other species, and the alcohol yield about the same as that of birch and lower than that of beech and sugar maple. On a cord basis, the comparison is not so favorable, owing to the comparatively light weight of bigleaf maple. The low yields given by bigleaf maple indicate that it can not be used for distillation in direct competition with eastern hardwoods. Furthermore, practically no acetate of lime is used on the coast at present, and the consumption of wood alcohol approximates the output of a single good-sized plant.

MISCELLANEOUS AND POTENTIAL USES

Boats.—The 10,000 feet of bigleaf maple reported under this classification in 1928 was used in the building of small commercial and pleasure boats, especially for decking, interior finish, ribs, and keel blocks.

General millwork.—Although earlier statistics show that the general millwork industry used bigleaf maple in considerable quantities, little or none of it was used by this industry in 1928. For practically all interior work, bigleaf maple is an excellent wood. The only limiting factor is supply.

Doors.—A small quantity of bigleaf maple veneer, both plain and figured, is used as a facing and cross-banding stock in the production of door panels.

Kitchen cabinets.—The bigleaf maple used in the production of kitchen cabinets, tables, and similar articles is reported under the heading Furniture.

Picture frames and molding.—As with kitchen cabinets, any bigleaf maple that may have been used in the production of mirror frames, mirror backs, picture molding, and picture backs is included under Furniture. Moderately light in weight, even in texture, working easily, carving readily, and taking an excellent mahogany, walnut, or enamel finish, it is a most desirable wood for such uses.

Shade and map rollers.—Bigleaf maple is well adapted for this general class of uses. It is especially suitable for curtain poles, because it turns well and because of the ease and permanence with which it takes stain and enamel.

Spools, reels, and bobbins.—The properties of bigleaf maple fit it for spools, reels, bobbins, and spindles. At present a certain quantity is used for reels.

Dowels and skewers.—Although bigleaf maple is well fitted for dowels, skewers, and similar rods or pins, very little of it has entered into this use.

Plumbers' woodwork.—Bigleaf maple is well adapted for toilet and medicine cases or cabinets, towel cabinets and racks, and other cabinet work for toilets, which may be finished to imitate the more expensive hardwoods, or enameled to match the tile work of the room.

Saddles.—The 4,000 board feet reported in 1928 was used in the production of pack saddles. Some bigleaf maple may also have been used in saddle trees; it has been used for this purpose in past

years. Hardness and strength are requisite in both uses. Pack saddles, in addition, call for a wood that checks and warps but little under adverse conditions.

Toys.—That very little bigleaf maple is used in the manufacture of toys is largely due to the small size of the toy industry in the Pacific Northwest. The wood is admirably suited, entirely or in part, for practically all classes of toys, such as the following: Wagons, wheelbarrows, kiddie cars, buggies, coasters, scooters, hobbyhorses, toy animals of various kinds, doll houses, toy furniture, gunstocks, and blocks.

Musical instruments.—Choice selections of curly bigleaf maple are used for violin backs and necks. A violin-back cutting which is 1 by 8½ by 18 inches in size and contains $1\frac{1}{16}$ board feet, sells for $4.

Charcoal.—Only one small concern at present is producing charcoal from bigleaf maple in considerable quantity and that in mixture with red alder. This concern in 1928 consumed about 2,000 cords of bigleaf maple, most of which was in the form of slab wood purchased from near-by mills at $2.75 per cord; one cord of bigleaf maple will yield from 650 to 700 pounds of charcoal. Most of the bigleaf maple charcoal is consumed by the poultry industry, only small amounts entering into the manufacture of black powder and steel. It is produced in beehive kilns, more or less makeshift retorts having proved unsatisfactory both in the quantity and quality of charcoal produced.

Fuel.—Except for the slab wood, which some concerns sell at about $5 per cord, and the relatively small amount of cordwood resulting from land clearing, very little bigleaf maple is used for fuel. It has a fuel value about 70 per cent of that of Oregon white oak, 74 per cent of eastern white oak, and 100 per cent of Douglas fir.

Maple sugar.—The sap of bigleaf maple, like that of sugar maple, is sweet, and can be made into sirup. Where the climate is favorable the flow of sap is considerable, but as far as can be determined from the records available very little use has been made of it as a source of maple sirup.

SEASONING

Manufacturers are not experiencing any special difficulties in seasoning bigleaf maple lumber. Except for a small amount used for handles and bent parts, all the cut is at least partially kiln-dried and some of it from the green condition. Many operators believe that lumber that has been partially seasoned in the air before being placed in the kiln gives a stock of better quality than that kiln dried direct from the saw. If the stock is partially seasoned, close control of temperature, humidity, and circulation in drying is unquestionably of less importance than if the stock is green at the time it enters the kiln. The kiln-drying process is slower than that for softwoods, but ordinarily represents merely the taking away of a comparatively small percentage of moisture, and the final moisture content is usually low. All these factors contribute to uniformity of final moisture content, with a minimum of checking, splitting, honeycombing, and warping. The lumber is air seasoned from 30 days to several

months, depending on the yard space available and to some extent on the volume of stock on hand. (Fig. 6.) Where yard space is

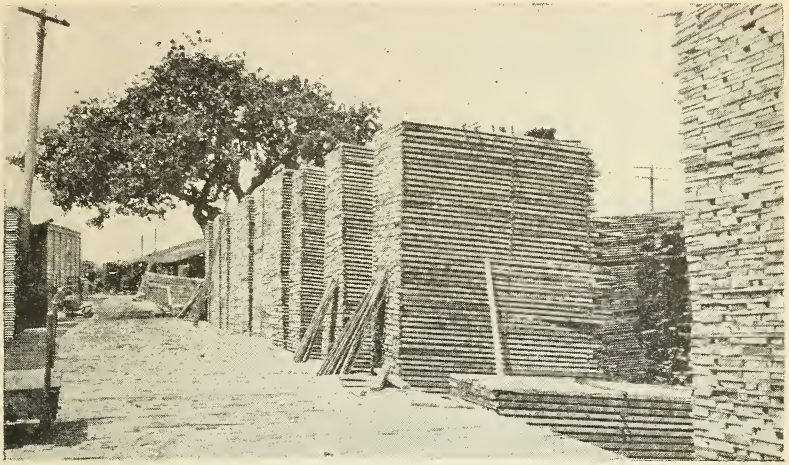


FIGURE 6.—Bigleaf maple lumber piled for air seasoning. Note the narrow piles, absence of spacing between boards in a layer, and excellent vertical alinement of special 1 by 3 inch stickers. In wider piles at least a 2-inch space between the boards in a layer is essential, unless "chimneys" are left open. Piles should be well covered in winter, with an overhang sufficient to protect both sides and ends

not available, which is often the case when factories produce their own lumber, the stock is piled on the kiln cars and allowed to season for 30 to 60 days before it is kiln dried. (Fig. 7.)

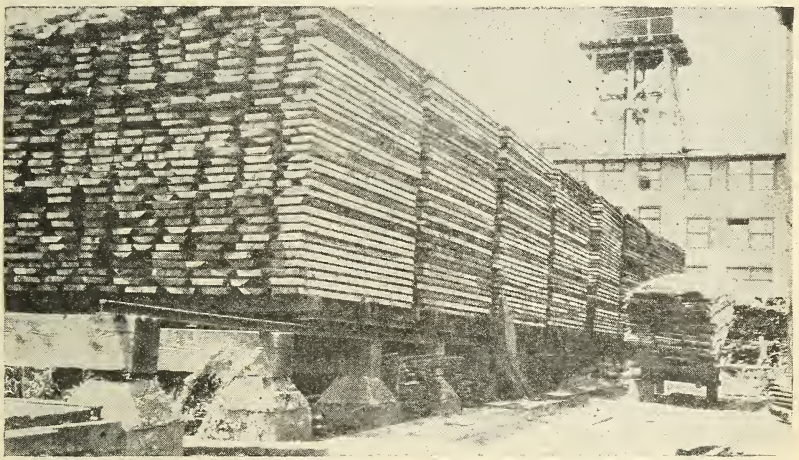


FIGURE 7.—Two-inch bigleaf maple piled on trucks for kiln drying. The green stock was piled on trucks as shown, and left to season in the air for about 30 days prior to kiln drying. Note the broken vertical openings or flues which result in piling random-width stock. The end splits did not develop during seasoning; they occurred during sawing, presumably as a result of internal stresses

The green lumber, regardless of the method of seasoning, should be piled in such a manner as to insure positive circulation throughout the entire pile or load. Close piled, it will begin to deteriorate with-

in a week or two during the summer months. (Fig. 8.) If it is left in this condition for any length of time serious damage from stain or decay is likely to result, the stain discoloring the wood, the decay decomposing the part attacked. Under the low temperatures and high humidities which may occur in the early stages of kiln-drying, wood-rot fungi may develop on the surface of the boards in a form closely resembling mold growth. Lumber cut from logs infected with decay organisms naturally contains these early stages of decay. Commercial-kiln conditions and steaming processes are effective in sterilizing infected wood up to and including pieces 4 inches thick.

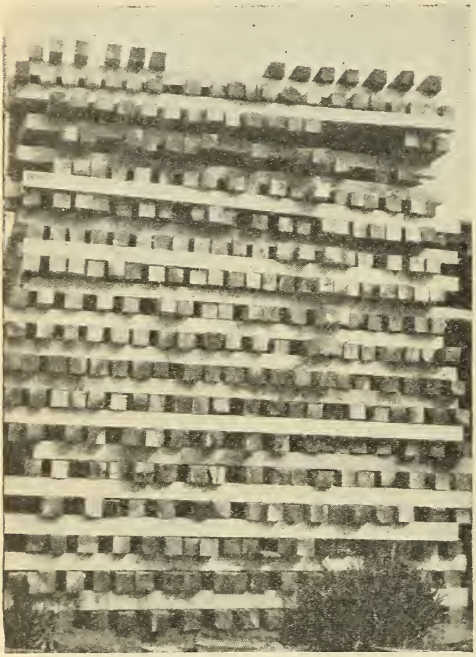


FIGURE 8.—Three by three inch bigleaf maple turning squares close-crib piled for air seasoning. The foundation construction and piling method illustrated afford inadequate means for circulation, with consequent slow drying and the likelihood of stained and end-checked lumber during the summer.

With a little additional care and expense the general practice in air seasoning bigleaf maple could be raised to the level of the best accepted practice. To insure adequate circulation of air throughout the pile and at the same time keep the lumber degrade down to the minimum, the foundation should be at least 16 inches high at the lowest point, the yard floor should be kept free of débris, the spaces between the boards in a layer should not be less than 2 inches wide, and special attention should be given to the character, number, and placing of stickers. (Fig. 9.) Weeds and other vegetation in the yard not only retard air movement under the piles, but also lower the rate at which the ground dries out after rains.

The general practice in air seasoning is to "self-stick" all lumber, except in 2-inch and thicker stock, for which some operators use special stickers 1 inch thick and 3 to 4 inches wide, usually of Douglas fir. Regardless of the thickness of the lumber, stock stickers should never be used where the lumber is to be left in the pile for any length of time, since such sticking practice often results in checked and stained lumber and in extreme cases in the development of wood-destroying fungi. The stickers should preferably be 1 inch thick and 2 or 3 inches wide and thoroughly seasoned. The tiers of stickers should be frequent enough to avoid sag, and the vertical alinement of each tier should be such that the stickers bear directly on those beneath, otherwise bowed lumber and other defects will result.

The rate of drying in the air varies, of course, with the season, size of stock, and method of piling. To air-dry bigleaf maple under shelter to a moisture content of 18 to 12 per cent requires 8 months to 2 years; 1¼ to 1½ inch stock for brush backs and handles is air-dried to 18 to 16 per cent in 8 to 10 months, and 2 by 2 inch handle blanks to 14 to 12 per cent in 18 months to 2 years. Stock that is to be kiln-dried is usually air seasoned at least 30 days.

Natural-circulation kilns, either of the progressive or compartment type, but generally the latter, are commonly used in the artificial drying of bigleaf maple lumber. That other types of kilns, especially those employing forced circulation, are not used more extensively with this species has no special significance. The natural-draft kiln is the cheapest type to install and requires the minimum

FIGURE 9.—Air-seasoning yard of sawmill producing bigleaf maple and other hardwood lumber exclusively. Rather poor drying conditions are here shown. Note the ineffective foundations, absence of spacing between the boards in a layer, insufficient space between the piles on the same alley, carelessness in the placement of stickers, and the presence of weeds and other vegetation

of care in operation. The fact that a progressive kiln with relatively lower flexibility and accuracy of control can be used satisfactorily indicates that bigleaf maple is not a difficult wood to dry. Operating instruments are limited to temperature and humidity recorders.

The practice in kiln-drying bigleaf maple is to flat pile the lumber, with the loads running lengthwise of the kiln and parallel to the heating coils. For effective circulation this method of piling probably can not be improved upon. In natural-circulation kilns the air movement within the pile is essentially vertical, with the air currents descending at some periods of the operation and ascending at other periods. With some combinations of heating-coil arrangements, lengthwise piling is advantageous, and with other combinations cross piling is advantageous.

The spacing between the boards or pieces in the individual layers of the load varies from 1 to 2 inches. The amount of space to leave in a particular case is a matter of judgment. Ordinarily 2 or 3

inches of open space to each 12 inches of stock width is sufficient for bigleaf maple. One space of 2 inches is better than two spaces of 1 inch, but the distances between spaces should not be over 14 inches. It is desirable for spaces in successive layers to be in vertical alinement in so far as possible. When random-width stock is stacked, boards may be grouped in successive layers in such a way that stock of the same approximate average width is kept in vertical alinement; in this way the continuity of vertical flues within the pile is maintained. The stickers, 1 inch thick and 1½ to 2 inches wide, are placed from 2 to 4 feet apart, the distance varying with the thickness of the stock. The spacing between tiers of stickers should be reasonably close, since warped lumber will result from too wide spacing.

No schedule for drying bigleaf maple satisfactorily in the shortest length of time has ever been worked out by intensive and systematic study. Manufacturers have drawn largely on their own experience and have been influenced by differences in operating conditions, with the result that the schedules in use, although apparently satisfactory, differ considerably.

Green 1-inch stock is dried to a moisture content of 10 to 5 per cent in 14 to 21 days, and green 2-inch stock to a moisture content of 5 per cent in about 30 days. The initial temperatures used at most of the plants vary from 100° to 110° F., with the final temperatures ranging from 170° to 180°. All operators maintain comparatively high humidities throughout the drying period. A relative humidity of 60 to 80 per cent is maintained during the early part of the run, dropping to 30 to 40 per cent at the end. Both green and partially air-seasoned stock is usually steamed at the beginning of the run, also during drying if the condition of the stock demands. Where the drying is forced, through the use of high temperatures and low humidities, honeycombing is likely to result (especially with thick stock), as well as checking, splitting, warping, and cupping.

The aim at chair and furniture factories is to dry the stock to a moisture content of about 5 per cent. After removal from the kilns the loads usually stand under shelter for several days, during which time there is some moisture pick-up. It is estimated that the stock at the time it is unpiled has a moisture content of 8 to 10 per cent.

The Forest Products Laboratory has worked out drying schedules on the basis of actual drying tests for sugar maple, red maple, and silver maple, and it would seem that the schedules developed for these woods could be safely applied to kiln-drying of bigleaf maple. Not only are these all diffuse-porous woods, but there is a marked similarity in essential physical characteristics, as is shown in Table 3. Bigleaf maple is probably a little easier to dry than sugar maple. It will be noted that the comparative shrinkage of bigleaf maple from green to oven-dried is less than that of sugar maple.

Table 4 gives drying schedules recommended by the Forest Products Laboratory for the three eastern maples referred to. Schedule 1 is intended for use with stock up to 6/4 inches in thickness, and Schedule 2 with thicker stock. It should be borne in mind, however, that the tendency of different woods to check is largely individual and does not follow the relative density or shrinkage of the wood.

Therefore, while the drying schedules for the eastern maples should prove satisfactory for bigleaf maple, it is recommended that higher humidities be used if excessive checking is encountered.

TABLE 3.—*Essential properties of bigleaf, sugar, red, and silver maples with reference to kiln drying*

Maple species	Specific gravity oven dry, based on volume when—		Weight per cubic foot		Comparative shrinkage, green to oven dry
	Green	Oven dry	Air-dry [1]	Kiln dry	
			Pounds	*Pounds*	*Per cent*
Bigleaf	0.44	0.51	34	32	11.3
Sugar	.57	.68	44	43	14.7
Red	.49	.55	38	36	12.8
Silver	.44	.51	33	32	11.4

[1] At 12 per cent moisture content.

TABLE 4.—*Schedules suggested for drying bigleaf maple* [1]

Moisture content	Schedule 1			Schedule 2		
	Dry-bulb temperature	Wet-bulb temperature	Relative humidity	Dry-bulb temperature	Wet-bulb temperature	Relative humidity
	°F.	°F.	*Per cent*	°F.	°F.	*Per cent*
Initial	130	123	80	125	118	80
40 per cent	135	126	75	130	121	75
30 per cent	140	128	70	135	123	70
25 per cent	145	128	60	140	123	60
20 per cent	150	127	50	145	122	50
15 per cent	155	124	40	150	120	40
10 per cent to final	160	115	25	155	111	25

[1] Schedule 1 is for stock up to 6/4 inches in thickness, and Schedule 2 for thicker stock.

By using the schedules given in Table 4, changes in temperature and humidity can be made as the moisture content of the sample passes the percentage indicated. It should be possible to obtain good results with faster drying, but the use of schedules more severe than these will require most careful judgment on the part of the kiln operator.

Preliminary steaming, which is a high-humidity treatment of a kiln charge, is recommended for reducing tension set in the outer layers of the individual pieces of air-dried or partially air-dried lumber. The humidity during initial steaming of air-dried stock should correspond to a moisture content 2 or 3 per cent higher than that of the surface layers of the stock, and the treatment should continue until the surface quarter inch has absorbed moisture enough to bring it into equilibrium with the humidity conditions. To hasten the treatment and to warm up the stock most satisfactorily, it is customary to use a temperature about 15° higher than that at which drying is to commence. The time required for such steaming will vary for 1-inch stock from a few hours to a day, depending on conditions. Initial steaming is often unessential, and it is far better not to steam air-dried lumber than to give the treatment improperly.

Preliminary steaming is also recommended for green stock, not to relieve stresses but to warm the stock thoroughly before drying operations begin. It is not necessary to steam green stock so long as partly seasoned stock, one hour per inch of thickness being sufficient. The temperature during steaming may be from 10° to 15° above the starting point of the schedule, and the humidity should be as near 100 per cent as possible.

The schedules given in Table 4 are equally applicable to green and partially dried stock. Once the preliminary steaming, if any, has been given, the drying may be started at the temperature and humidity corresponding to the moisture content of the stock as it entered the kiln. The whole of the schedule selected will, as a rule, be used only when drying green stock. Stock that has been air-dried usually has a more moderate moisture gradient than stock that has reached the same average moisture content in kiln drying and for this reason, if the stock is in good condition, a schedule somewhat more severe than the one specified can be used for it. To do this successfully, however, requires both skill and care.[5]

METHODS OF LUMBERING

Most of the bigleaf maple timber is logged by operators engaged solely in logging hardwoods, who cut their own timber and sell their logs to the mills or factories. Only in a few cases do sawmill owners engage in logging, although in order to provide a regular and satisfactory supply of logs they sometimes finance logging operators. Even mill operators owning stumpage near the mill usually contract the logging. About two-thirds of the bigleaf maple lumber consumed by the secondary wood-using industries is sawed by the factories themselves, the remainder by independent sawmills.

Because of the scattered character of the stand, the consequent small logging units, and the uncertainties in demand and price for both logs and lumber, the logging and milling of bigleaf maple by independent operators has been conducted on a small scale and in the main has not proved a steady or lucrative business. As would be expected under such conditions, most of the logging and some of the milling operations are marked by an absence of the specialization and high-class management that are found in the softwood industry of the region. The independent operators, moreover, are usually men of small means, and not infrequently they are relatively inexperienced. The sawmills of the secondary industries, although they are also in the main simple and often seemingly inadequate, produce lumber of satisfactory quality with comparatively little wood waste.

LOGGING

The joblike character of much of the hardwood lumber industry of the region is especially noticeable in logging. Many of the operators are ranchers who engage intermittently in the logging of

[5] Those interested in a discussion of the fundamental facts about the drying of wood are referred to the following bulletin: THELEN, R. KILN DRYING HANDBOOK. U. S. Dept. Agr. Bul. 1136. Rev. ed., 96 p., illus. 1929. Reprinted 1930. The major portion of this bulletin deals with the kiln drying of lumber, but there are also included specific suggestions concerning the drying of other forms of wood. The general information is applicable to all kinds of drying.

bigleaf maple and other hardwoods as a side line. A crew may consist of only three to five men, any one of whom may work at the different steps in the operation. Independent operators of this general character deliver bigleaf maple logs to the sawmills at prices ranging from $12 to $24 per M feet board measure; $17 to $24 per M in the case of the more distant and usually larger mills, and $12 to $15 per M to the nearer and smaller mills.

The timber is skidded with horses, generally direct to the mill, railroad, or towable water if the distance does not exceed one-half mile. For longer hauls wagons or autotrucks are resorted to, and then the skidding distance is not ordinarily more than 500 feet. The wagon or auto haul to mills located in the woods seldom exceeds 1 mile. Most of the mills, of course, are located long distances from the timber; the cost of conveying the logs from the woods landings to the distant mills is dealt with under the heading Transportation.

Because of differences in the volume per acre, size of timber, character of ground, and hauling distances, also because reliable cost records are not available, little more than approximations of bigleaf maple logging costs can be given. For low and high costs per thousand feet board measure, these are:

Operation	Low	High
Felling and bucking	$2.50	$3.50
Skidding, not to exceed ½ mile	2.00	4.00
Hauling, not to exceed 2 miles	2.50	4.00
	7.00	11.50

Utilization in the woods is fairly close. Most of the bigleaf maple cut runs from 16 to 24 inches in diameter at the stump, but 12-inch and 14-inch trees are taken. Tops are utilized up to an 8-inch diameter, size and frequency of the limbs permitting. The logs are usually cut in 8, 9, 10, and 12 foot lengths; the 8 and 9 foot logs, which include no trimming allowance, are produced for the sawmills operated by the secondary industries, whereas the longer logs are cut for the independent mills. When the timber is to be rafted and towed, it is occasionally logged in whole-tree lengths and later sawed into the desired log lengths at the sawmill. Veneer logs are sometimes cut 6 feet long.

MILLING

Most of the mills sawing bigleaf lumber are small, having a daily capacity of 1,500 to 4,000 board feet. (Fig. 10.) In no case does the daily capacity of the hardwood mills of the region exceed 10,000 feet. Some of the mills are located in or very near the timber; other and larger mills owned by independent manufacturers are located centrally in the bigleaf maple regions, but at some distance from the timber, so that their log supply has to be transported by railroad, water, or autotruck; those operated by the furniture and chair industries produce the bulk of bigleaf maple lumber and are usually at a considerable distance from the timber.

The equipment of the small independent mills, as well as that used by the chair factories, is of the simplest order, usually consisting of a circular head saw, a bolter carriage or a carriage with headblocks and setworks, track, and dead rolls. In the larger mills this layout is supplemented by a cut-off saw, pony edger, and live rolls. In one case the logs which have been slabbed on two sides by the circular head saw are worked down by a bolter mill, and in another the cants are converted into small sizes by a gang mill. (Fig. 11.) In only two instances, so far as known, are band head saws used. The circular head saws, 44 to 56 inches in diameter and of the inserted-tooth type, cut a $\frac{3}{16}$-inch to $\frac{5}{16}$-inch kerf. Many of the carriages will accommodate 24-foot logs, but the logs as a rule do not exceed 12 feet in length. Logs for bolter mills seldom exceed 8 feet.

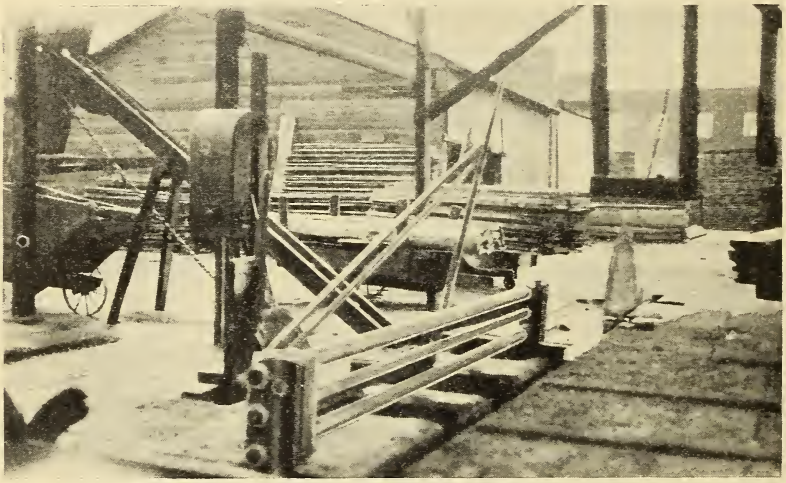


FIGURE 10.—Simplest type of sawmill used in sawing bigleaf maple logs. This type of mill is used at some of the chair and furniture factories, as well as in the timber. A carriage with headblocks and setworks is often substituted for the bolter carriage shown

The power for mills located near the timber is usually supplied by a steam or gasoline tractor, or, when the supply of timber warrants, a stationary engine and boiler are sometimes used. The more permanent, centrally located mills, including those operated in connection with the wood-using factories, are driven with steam or electricity, more often the latter. Too often the smaller mills are underpowered, which results in increased cost of production and poorly manufactured stock.

The output of the mills varies largely with the character of the equipment and the size of the crew. A small mill such as is shown in Figure 10, with a crew of two or three men, produces from 2,000 to 3,000 feet per day. The use of a carriage with headblocks and setworks, an edger, and cut-off saw, together with the services of two additional men, will increase the daily output 3,000 or 4,000 feet. The largest and best-equipped mills employing 6 to 10 men saw 8,000 to 10,000 feet of bigleaf maple lumber per day.

Bigleaf maple logs differ in size and quality and the lumber in thickness and grade. This variation, together with the fact that some of the small operators, especially the independent manufacturers, are relatively inexperienced and inefficiently equipped, results in differing operating costs. In some mills the cost will run as high

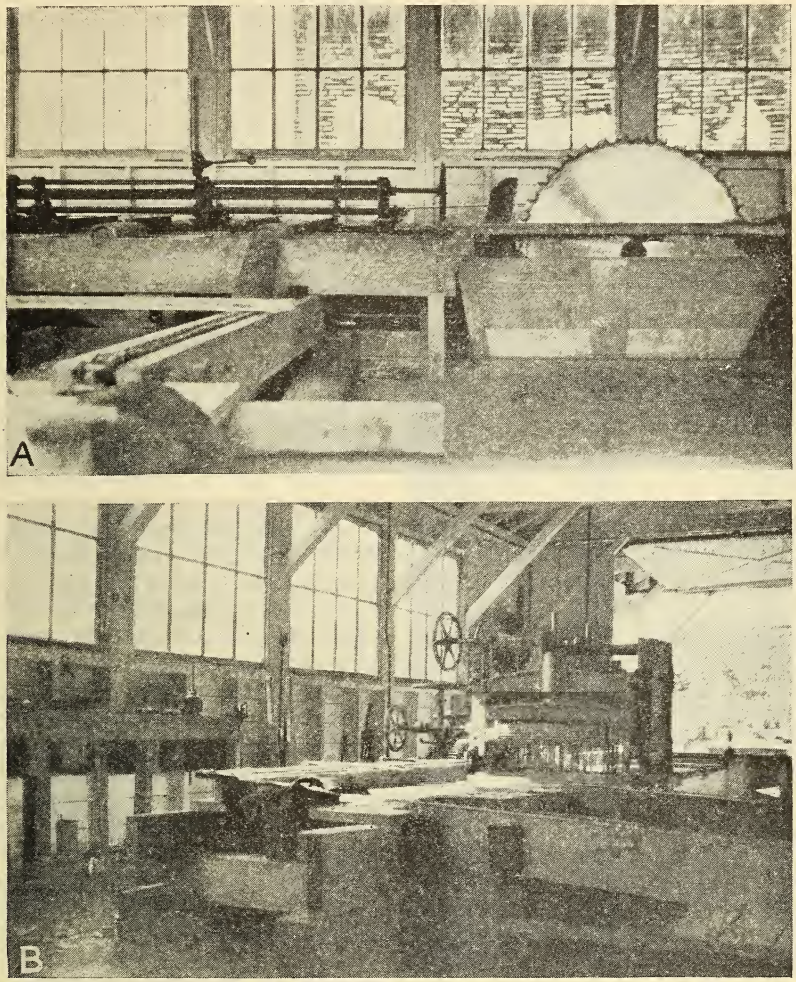


FIGURE 11.—One of the largest mills used in sawing bigleaf maple: A, The circular head saw (inserted-tooth type, 56 inches in diameter), bolter carriage, and transfer chain; B, 24-inch gang saw with maximum cutting depth of 8 inches and live rolls at front and rear of gang. This electrically driven mill is also equipped with a 24-inch cut-off saw

as $10 per thousand feet; in others, where round-edged lumber is sawed, as low as $6 per thousand.

Sawing practices differ as widely as mill layouts. The independent manufacturer usually squares the log by slabbing or sawing and then saws the squared logs through and through into boards 4/4, to 12/4 inches in thickness, mostly 4/4, 6/4, and 8/4 inches. In some

mills, however, the logs are slabbed on two sides and then worked down into lumber of the desired thickness by a bolter mill or a gang mill. If the mill is not equipped with an edger, the round-edged boards are edged with the head saw.

In the mills operated in connection with secondary wood-using industries, which produce the bulk of the bigleaf maple lumber, a thin slab is sawed from one side, or two opposite sides, of the log. The resulting cant is then sawed through and through into round-edged lumber, ready for the cut-up plant. The use of round-edged lumber increases the percentage of the log utilized, by saving for small turning squares a portion of the material that would have been wasted had the boards been edged; the practice is of special merit in chair manufacture.

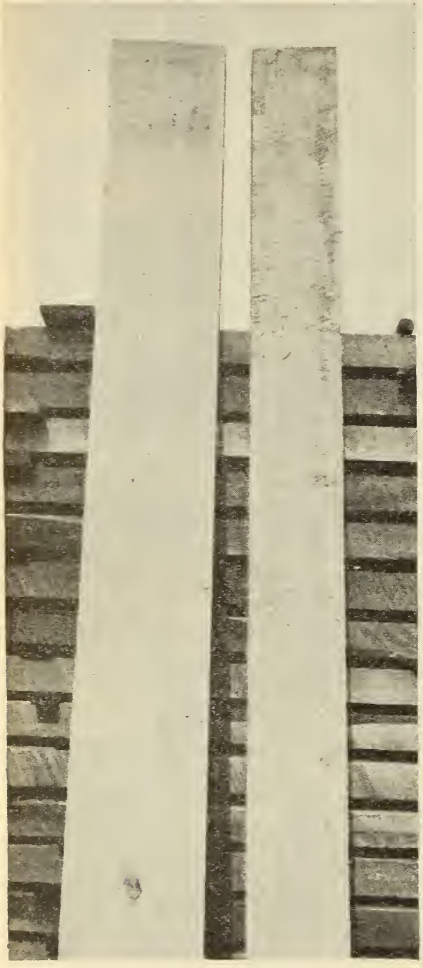


FIGURE 12.—Two-inch bigleaf maple boards. The board at the right is clear. The other shows two of the characteristic defects, a rotten knot and rotten streak

Because of the small size of much of the timber and the character of its growth, bigleaf maple ordinarily yields only a small percentage of "clear" lumber, seldom more than 10 and generally about 5 per cent. Characteristic lumber defects include sound and rotten knots, rotten streaks, and bark pockets. Longitudinal end splits of a foot or more (fig. 7), probably the result of internal stresses set up in the wood during growth, are common. Figure 12 shows a 2-inch board with a rotten knot and streak, and also a clear board.

Bigleaf maple logs are customarily scaled by the Scribner rule. The use of either the Scribner rule or the Doyle rule results in a large overrun in small logs. Although no mill-scale study has been made on bigleaf maple logs, reports indicate that the lumber tally exceeds the log scale 20 per cent or more. Some operators reported an overrun of 25 per cent.

TRANSPORTATION

Bigleaf maple in the form of logs or lumber is transported rather long distances to the consuming factories, located largely in Seattle, Tacoma, and Portland. As a result, transportation costs, not includ-

ing the first mile or so of haul in the woods, represent a considerable proportion of the total cost of the lumber to the consumer. Of the logs sawed by the furniture, chair, and other secondary wood-using factories, constituting about two-thirds of the cut, about 70 per cent are transported by rail, 24 per cent by water, and the remainder by autotruck. Of those sawed by the independent sawmills, representing some 35 per cent of the cut, about 45 per cent are transported by rail, 30 per cent by water, and the remainder by autotruck. Practically all the bigleaf maple lumber produced by the independent mills is transported to the consuming point by common-carrier railroads.

BY WATER

The rafting and towing of bigleaf maple logs is limited to Puget Sound and the Columbia and Willamette Rivers. Occasionally the rafts are made up entirely of bigleaf maple, but usually they consist of 20,000 to 60,000 board feet each of mixed hardwoods. They are constructed in various ways, but in all cases the logs are bound together; the logs ride low and tend to duck under the boom sticks and so to get away.

A common method of making up a raft is to bind the logs in a tier by means of a cable passed through an eyebolt driven in the middle of each log, the cable ends being fastened to the front and rear boom sticks. Sometimes the eyebolts are driven near the end of the log instead of the middle. Four tiers of about 40 logs each constitute a section, and five to six sections a raft or tow. When tree-length logs are towed they are fastened together in sections by means of a chain passed through a 2¼-inch hole bored through the small end of each log, a common method in assembling and towing piling.

No definite towage rates have been established by towing companies, doubtless because of the comparatively small quantity of hardwoods moved by water, the small size of the rafts, and the fact that hardwood rafts are usually made up at points off the regular towing routes. As a result, towage charges vary considerably. In many cases a job price, based on the time required to make the round trip, is quoted, with little or no consideration given to the size of the tow. Rates quoted on a thousand-foot basis range from $1.60 to $2.50 for a 40 or 50 mile tow, with proportionately lower rates for shorter distances. So far as known, 125 miles is the maximum towing distance in the region, the rate amounting to about $7 per thousand feet.

BY AUTOTRUCKS

About 12 per cent of the total cut of the bigleaf maple logs is transported by autotrucks to the mills, usually over distances of 10 or 12 miles and seldom more than 20 or 25 miles. Occasionally, high-priced veneer logs are trucked 60 to 75 miles. Many of the woods operators own trucks, some hire them by the day or trip, and a few contract the hauling on a footage basis. The cost of auto transportation averages $4 to $8 per thousand feet.

Only a very small quantity of bigleaf maple lumber is transported by autotrucks, and that largely from mills located near the consuming centers and on a job-rate basis.

BY RAILROAD

The major portion of the cut of bigleaf maple is transported by common-carrier railroad, in the form of logs to the centrally located mills and wood-using factories, and in the form of lumber from both the woods and centrally located mills to the wood-using factories.

In Oregon and Washington freight charges on both logs and lumber are based on the weight of the shipment. Maple logs weigh from 9,000 to 12,000 pounds per M feet board measure, log scale; green lumber, 4,500 to 5,000 pounds per M; and kiln-dried lumber, with a moisture content of about 8 per cent, 2,400 to 2,600 pounds per M. The small size of the timber precludes a large log scale per car, a load usually averaging from 7,000 to 9,000 feet board measure.

The largest portion of the logs shipped by rail originates in Washington. In Washington logs for rail shipment are cut in 8 and 9 foot lengths, in Oregon in 8-foot lengths. These are very satisfactory lengths for lumber manufacture, as well as car loading. The Great Northern, Northern Pacific, Union Pacific, and the Chicago, Milwaukee, St. Paul, and Pacific railway companies have established the distance rates given in Table 5. These rates apply only to carload lots of a minimum weight of 50,000 pounds. Point-to-point rates over the Southern Pacific lines in western Oregon are shown in Table 6.

TABLE 5.—*Freight rates on 8 and 9 foot bigleaf maple logs, western Oregon and Washington, 1929*

Distance	Rate per 100 pounds	Distance	Rate per 100 pounds
	Cents		*Cents*
Not over 5 miles	[1] 2	Over 130, not over 150 miles	6
Over 5, not over 30 miles	[1] 3	Over 150, not over 170 miles	6. 5
Over 30, not over 50 miles	3. 5	Over 170, not over 190 miles	7
Over 50, not over 70 miles	4	Over 190, not over 220 miles	7. 5
Over 70, not over 90 miles	4. 5	Over 220, not over 250 miles	8
Over 90, not over 110 miles	5	Over 250, not over 280 miles	8. 5
Over 110, not over 130 miles	5. 5	Over 280, not over 290 miles	9

[1] Minimum charge of $15.50 per car.

TABLE 6.—*Point-to-point freight rates on bigleaf maple logs established for western Oregon by the Southern Pacific Railroad Co., 1929*

Oregon shipping point	Oregon delivery point	Distance	Rate per 100 pounds
		Miles	*Cents*
Molalla	Portland	35	5
Silverton	do	46	5
Willamina	do	65	7
Black Rock	do	81	7. 5
Labanon	do	85	7. 5
Mill City	do	91	8. 5
Blodgett	do	108	8. 5
Tillamook	do	121	9. 5
Creswell	do	136	9. 5
Wendling	do	145	10. 5
Toledo	do	151	10. 5
Oakridge	do	167	11. 5
Coquille	do	260	15
Molalla	New Era	14	3. 5
Mount Angel	do	21	[1] 3. 5
Silverton	do	25	3. 5
Carlton	do	52	[1] 5
Lebanon	do	64	6

[1] Minimum carload lots of a weight of 60,000 pounds; other rates based on a minimum carload weight of 50,000 pounds.

TABLE 6.—*Point-to-point freight rates on bigleaf maple logs established for western Oregon by the Southern Pacific Railroad Co., 1929*—Continued

Oregon shipping point	Oregon delivery point	Distance	Rate per 100 pounds
		Miles	*Cents*
Willamina	New Era	74	7
Elk City	do	121	[1] 7.5
Toledo	do	131	9.5
Mapleton	do	160	[1] 7
Coquille	do	240	14
Powers	Marshfield	45	5
Rainrock	do	68	7
Corvallis	do	155	11
Silverton	do	202	13.5

[1] Minimum carload lots of a weight of 60,000 pounds; other rates based on a minimum carload weight of 50,000 pounds.

LUMBER RATES

Rates on bigleaf maple lumber are quoted both on a mileage and point-to-point basis by the Northern Pacific, Great Northern, and Chicago, Milwaukee, St. Paul, and Pacific railway companies, as shown in Tables 7 and 8. The distance rates established by the Southern Pacific Railroad Co. are given in Table 9.

TABLE 7.—*Freight rates on bigleaf maple lumber, Oregon and Washington, 1929* [1]

Distance	Rate per 100 pounds	Distance	Rate per 100 pounds
	Cents		*Cents*
Not over 5 miles	7	Over 90, not over 100 miles	17
Over 5, not over 20 miles	8.5	Over 100, not over 140 miles	17.5
Over 20, not over 25 miles	9	Over 140, not over 150 miles	18.5
Over 25, not over 45 miles	10.5	Over 150, not over 170 miles	20
Over 45, not over 50 miles	11	Over 170, not over 200 miles	21.5
Over 50, not over 65 miles	13	Over 200, not over 225 miles	24.5
Over 65, not over 75 miles	13.5	Over 225, not over 250 miles	25
Over 75, not over 90 miles	16	Over 250, not over 275 miles	27

[1] Minimum carload weight of 50,000 pounds.

TABLE 8.—*Point-to-point freight rates on bigleaf maple lumber, Oregon and Washington, 1929* [1]

Shipping point	To Portland, Oreg.		To Tacoma, Wash.		To Seattle, Wash.	
	Distance	Rate per 100 pounds	Distance	Rate per 100 pounds	Distance	Rate per 100 pounds
	Miles	*Cents*	*Miles*	*Cents*	*Miles*	*Cents*
Astoria, Oreg.			254	22	283	22
Portland, Oreg.			145	12.5	183	15.5
Yacolt, Wash.	40	6.5				
Kelso, Wash.	48	7	95	12.5	135	15.5
Raymond, Wash.	136	12	114	11.5	151	12
Chehalis, Wash.	87	10	55	11.5	95	12
Centralia, Wash.	91	11.5	50	7.5	90	11.5
McCleary, Wash.	159	12	67	9.5	106	12
Shelton, Wash.	149	14.5	72	11.5	112	12
Oakville, Wash.	110	12	68	7.5	102	11.5
Aberdeen, Wash.	145	12.5	95	11.5	135	12
Olympia, Wash.	117	12	35	6.5	75	9.5
Auburn, Wash.	160	14.5	17	5	21	6.5
Tacoma, Wash.	145	12.5			38	6.5
Seattle, Wash.	183	15.5	38	6.5		
Maple Valley, Wash.	205	19	41	6.5	21	5.5
Black Diamond, Wash.	194	20.5	50	11.5	30	6.5
Issaquah, Wash.	214	18.5	72	9	43	6.5
Monroe, Wash.	233	18.5	88	9	49	7
Sedro-Woolley, Wash.	258	22.5	115	12	80	9.5
Snohomish, Wash.	210	18.5	67	9	38	6.5

[1] Minimum carload weight of 50,000 pounds.

TABLE 9.—*Freight rates on bigleaf maple lumber established by Southern Pacific Railroad Co., for Oregon, 1929*

Distance	Rate per 100 pounds	Distance	Rate per 100 pounds
	Cents		*Cents*
Not over 25 miles	7	Over 185, not over 205 miles	26
Over 25, not over 40 miles	9	Over 205, not over 225 miles	27
Over 40, not over 50 miles	10. 5	Over 225, not over 245 miles	29. 5
Over 50, not over 60 miles	12. 5	Over 245, not over 265 miles	30
Over 60, not over 70 miles	13. 5	Over 265, not over 285 miles	33
Over 70, not over 85 miles	16	Over 285, not over 305 miles	34
Over 85, not over 110 miles	17	Over 305, not over 325 miles	36
Over 110, not over 125 miles	19. 5	Over 325, not over 345 miles	37. 5
Over 125, not over 150 miles	20. 5	Over 345, not over 365 miles	38. 5
Over 150, not over 165 miles	22. 5	Over 365, not over 385 miles	39. 5
Over 165, not over 185 miles	24		

[1] Minimum carload weight of 50,000 pounds.

STUMPAGE, LOG, AND LUMBER VALUES

Bigleaf maple stumpage in small, poorly located units with scattered timber may sell for as low as $0.75 per M feet, but when stumpage contains a comparatively high percentage of logs suitable for veneer it may bring as much as $5. Stumpage within a mile or two of existing transportation facilities, such as a good road, "towable" water, or a railroad, is ordinarily worth from $1.50 to $2.25 per M or, if good-sized and exceptionally well located, $2.50 to $3.50 per M.

Except for the small quantity of specially selected logs used in veneer manufacture, bigleaf maple logs are usually sold on a camp-run basis. Although the size and quality of the logs are taken into consideration, the location of the mill with reference to the timber and transportation facilities largely fixes the price. Table 10 gives average, high, and low prices paid for camp-run logs delivered to the different classes of mills.

TABLE 10.—*Camp-run prices of maple logs per thousand feet board measure, delivered to mills, 1928*

Location of mill	Average	High	Low
In timber	$8	$10	$7
On highway	16	18	15
On tidewater	20	22	16
On railroad	22	24	17

Veneer logs of a grade suitable for the manufacture of plain veneer sell for $22 to $26 per M feet b. m.; such logs are usually 18 inches and more in diameter and 6 to 8 feet in length, as well as straight, sound, surface clear, well rounded, and with the minimum of taper. Veneer logs yielding highly figured stock sell for $40 to $60 per M.

Because of the relatively small quantity cut and the character of its use, lumber grades have not been established for bigleaf maple. Except for an occasional small sale of clear stock, the lum-

ber is sold "mill run with culls out," culls being considered as lumber so defective as to contain little material of value.

Table 11 shows average, low, and high prices paid in 1928 for green bigleaf maple lumber delivered to the principal consuming centers. Prices paid for stock of different thicknesses are practically the same; the 3-inch and 4-inch stock, which represents but a small percentage of the cut, brings only $2 to $3 more per M than the thinner stock. Moreover, the price paid for partially air-seasoned lumber is substantially the same as that paid for green lumber. The partially seasoned stock occasionally brings $2 or $3 more per M. Of course, since the price of bigleaf maple lumber is generally quoted f. o. b. delivery point, the producer who ships by rail actually receives more for partially air-seasoned stock; the lumber is lighter in weight and so the cost of transportation is less.

TABLE 11.—*Mill-run prices of green bigleaf maple lumber per thousand feet board measure, delivered to wood-using factories, 1928*

Delivery point	Average	High	Low
Portland, Oreg.	$32	$38	$30
Tacoma, Wash.	35	36	32
Seattle, Wash.	35	38	32

The large users of bigleaf maple prefer to kiln-dry their own stock, with the result that the demand for kiln-dried bigleaf maple lumber is largely confined to small users. Prices paid for kiln-dried stock in 1928 ranged from $45 to $75 per M feet b. m.; $50 to $75 in Seattle and Tacoma, and $45 to $60 in Portland. The wide range in these prices was due to the variation in the grade of the lumber, the stock bringing $75 per M consisting mostly of clear lumber.

CLASSIFIED LIST OF USES FOR BIGLEAF MAPLE [6]

REPORTED USES

Automobile bodies—cross braces, fillers, posts, sills, top frames.
Bedsteads—posts, rails, spindles.
Boards—cutting, pressing.
Boats (small)—decking, interior finish, keel blocks, ribs.
Brush backs.
Buffets—crowns, legs, posts, rails.
Cabinets, sewing.
Cases, book, wall.
Chairs, bedroom—enamel finish—all parts; living and dining room—with walnut or mahogany finish, all parts; office, library, and college—natural finish, all parts; overstuffed, seat and back frames, legs; upholstered—arms, arm and back posts, legs, rails, top slats; rockers—walnut or mahogany finish, arms, arm and back posts, rims, runners, seats, seat frames, slats, spindles; cheap grade—crowns, rims, runners, seats, top slats.
Charcoal.
Chests—crowns, legs, posts, rails.
Chiffoniers—legs, mirror frames and posts, posts, rails; enamel finish, all parts.
Counters—framing, rails, tops.
Cores, veneer.

[6] A directory of producers and consumers of bigleaf maple will be furnished on request by the Pacific Northwest Forest Experiment Station, Portland, Oreg.

Davenports—frames, legs, molding, rails.
Doors—panel facing and cross-banding.
Dowels.
Drawers—ends, sides.
Dressers—legs, mirror frames and posts, posts, rails; enamel finish, all parts.
Fixtures, store.
Frames, mirror.
Handles—brush, pick, shovel, small tool.
Instruments, musical—violin necks and backs.
Mulching—lawns and nursery and ginseng beds.
Panels—backing, cross-banding, facing, inlays, overlays.
Racks, wall.
Rollers—house moving, offbearing.
Saddles, pack—sawbuck.
Servers—crowns, legs, posts, rails.
Shelving.
Stands, smoke.
Spoons, cooking.
Stools—foot, piano.
Tables, walnut or mahogany finish—legs, rails, slides, stretchers, and all parts of small tables.
Tables, breakfast—enamel finish.
Tables, dressing—legs, mirror frames and posts, posts, rails.
Vanities—legs, mirror frames and posts, posts, rails; enamel finish, all parts.
Wagons, tea—enamel finish.

POSSIBLE USES FOR BIGLEAF MAPLE

Action, piano.
Automobile bodies—dashboards, door frames, floor boards, pillars, posts, running boards, seat risers.
Balls, croquet.
Baskets—berry, fruit.
Boards—bread, ironing, lap, cutting.
Bobbins.
Boxes, cheese.
Brushings, pulley.
Bungs.
Cabinets—kitchen, medicine, toilet.
Candlesticks.
Clubs, Indian.
Dumb-bells.
Ferneries.
Frames, picture.
Handles, broom.
Hangers, garment.
Ladders, rungs.
Ladles, butter.
Lamps—floor, stand.
Mashers, potato.
Molding, picture.
Molds, butter.
Mauls, meat.
Pedestals.
Pegs, shoe.
Pins, rolling.
Pulleys.
Racks—clothes, display, towel.
Rods, curtain.
Rollers—map, shade.
Saddle trees.
Shuttles.
Slats, trunk.
Soles, wood shoe.
Spindles.
Spools.
Stands, telephone.
Stakes, tent.
Sweeper, carpet.
Taborets.
Tenpins.
Toggles, tent.
Toys.
Tubs—butter, lard.
Washboards.

SUMMARY

Bigleaf maple, one of the few commercial hardwoods of the Pacific Northwest, grows on the Pacific coast from southern Alaska to southern California, but generally as an incidental species in mixture with more important softwoods. It reaches its best development on bottoms and springy hillsides in the coastal region of Oregon and Washington, at times occurring in almost pure stands of limited area.

Although on good soils bigleaf maple frequently reaches 100 feet in height and 40 inches in diameter, over most of its range it is a small tree, averaging less than 50 feet in height and 18 inches in

diameter, with a marked tendency toward poor form. Little is known as to the volume of the merchantable stand, except that it is so small as to prevent the tree from being used to a much greater extent than at present for commercial purposes. The lumber cut in Oregon and Washington in 1928 amounted to about 8,500,000 board feet, or less than 0.2 per cent of the total cut of hardwood lumber in the United States. The importance of bigleaf maple is due both to the intrinsic qualities of the wood and to the scarcity of other hardwoods in the Pacific Northwest.

The wood resembles that of the eastern species. It has the same light color and fine grain, but it is lighter in weight than any of the eastern maples except silver maple. Although not so hard or strong as sugar maple, it is superior to silver maple in all mechanical properties except shock-resisting ability. Its chief use is for medium-grade furniture and chairs, especially for legs, posts, stretchers, and other turned parts. In 1928 about 95 per cent of the cut was used by factories in Oregon and Washington for making furniture and chairs.

ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE WHEN THIS PUBLICATION WAS LAST PRINTED

Secretary of Agriculture	ARTHUR M. HYDE.
Assistant Secretary	R. W. DUNLAP.
Director of Scientific Work	A. F. WOODS.
Director of Regulatory Work	WALTER G. CAMPBELL.
Director of Extension Work	C. W. WARBURTON.
Director of Personnel and Business Administration.	W. W. STOCKBERGER.
Director of Information	M. S. EISENHOWER.
Solicitor	E. L. MARSHALL.
Weather Bureau	CHARLES F. MARVIN, *Chief.*
Bureau of Animal Industry	JOHN R. MOHLER, *Chief.*
Bureau of Dairy Industry	O. E. REED, *Chief.*
Bureau of Plant Industry	WILLIAM A. TAYLOR, *Chief.*
Forest Service	R. Y. STUART, *Chief.*
Bureau of Chemistry and Soils	H. G. KNIGHT, *Chief.*
Bureau of Entomology	C. L. MARLATT, *Chief.*
Bureau of Biological Survey	PAUL G. REDINGTON, *Chief.*
Bureau of Public Roads	THOMAS H. MACDONALD, *Chief.*
Bureau of Agricultural Engineering	S. H. MCCRORY, *Chief.*
Bureau of Agricultural Economics	NILS A. OLSEN, *Chief.*
Bureau of Home Economics	LOUISE STANLEY, *Chief.*
Plant Quarantine and Control Administration.	LEE A. STRONG, *Chief.*
Grain Futures Administration	J. W. T. DUVEL, *Chief.*
Food and Drug Administration	WALTER G. CAMPBELL, *Director of Regulatory Work, in Charge.*
Office of Experiment Stations	JAMES T. JARDINE, *Chief.*
Office of Cooperative Extension Work	C. B. SMITH, *Chief.*
Library	CLARIBEL R. BARNETT, *Librarian.*

This circular is a contribution from

Forest Service	R. Y. STUART, *Chief.*
Branch of Research	EARLE H. CLAPP, *Assistant Forester, in Charge.*
Pacific Northwest Experiment Station.	T. T. MUNGER, *Director.*

1 AE U. S.
Ag84C Ci
201-225
JUN 1
NOV 4 - 1936 NOV 6
APR 11 1940
GPO 8—2432

NATIONAL AGRICULTURAL LIBRARY
1022831630